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(54) Torque converter

(57) A torque converter comprising a first shell 22 at an input side; a gear pump connected to the first shell 22; a second shell 49 coaxial to the first shell 10 and having impeller blades 48; and a clutch disposed between the shells 22, 49 and operable to engage when a rotation speed at the input side exceeds a predetermined idling value. The clutch may comprise radially-movable shoes (53) as shown, or may be a multi-plate clutch actuated by radially-movable wedges. Hydraulically- or electrically-actuated clutches may also be used. The clutch precludes creep when idling.

FIG. 3

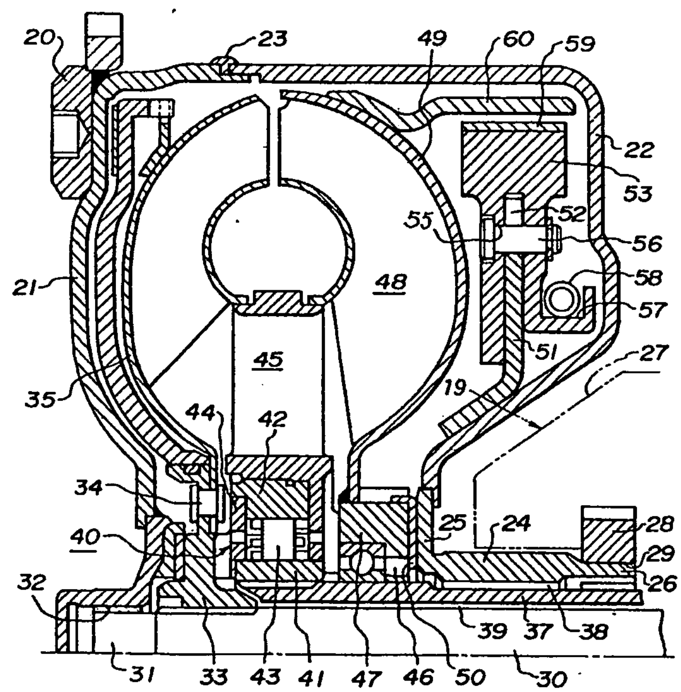

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FIG. 1

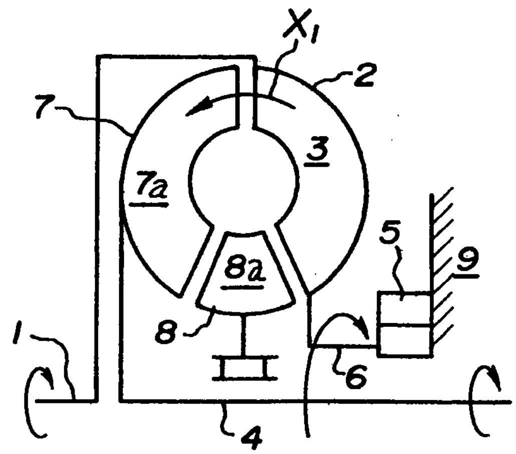

FIG. 2

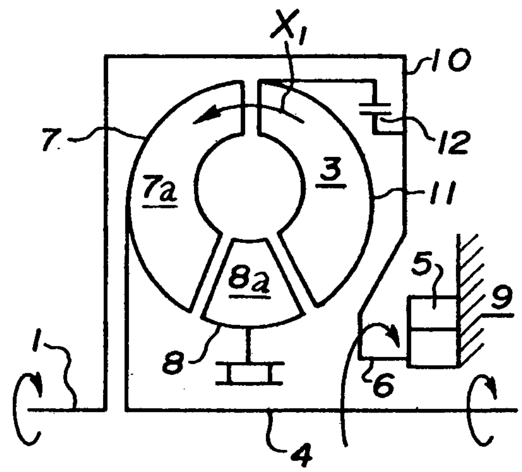

FIG.3

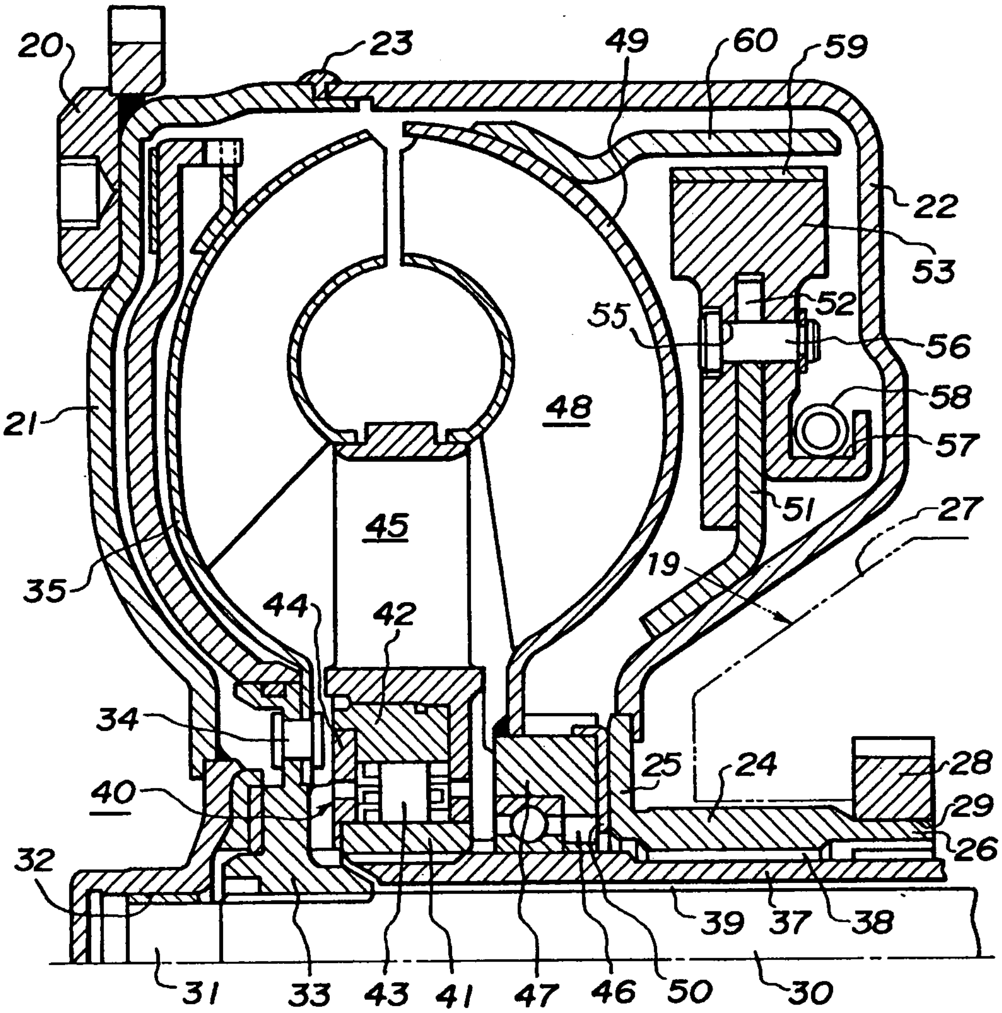

FIG.5

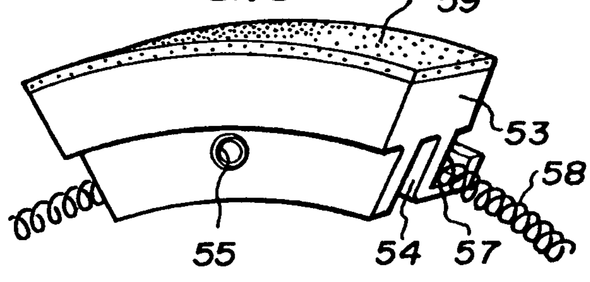

FIG.4

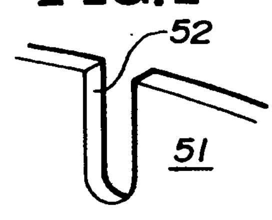

FIG.6

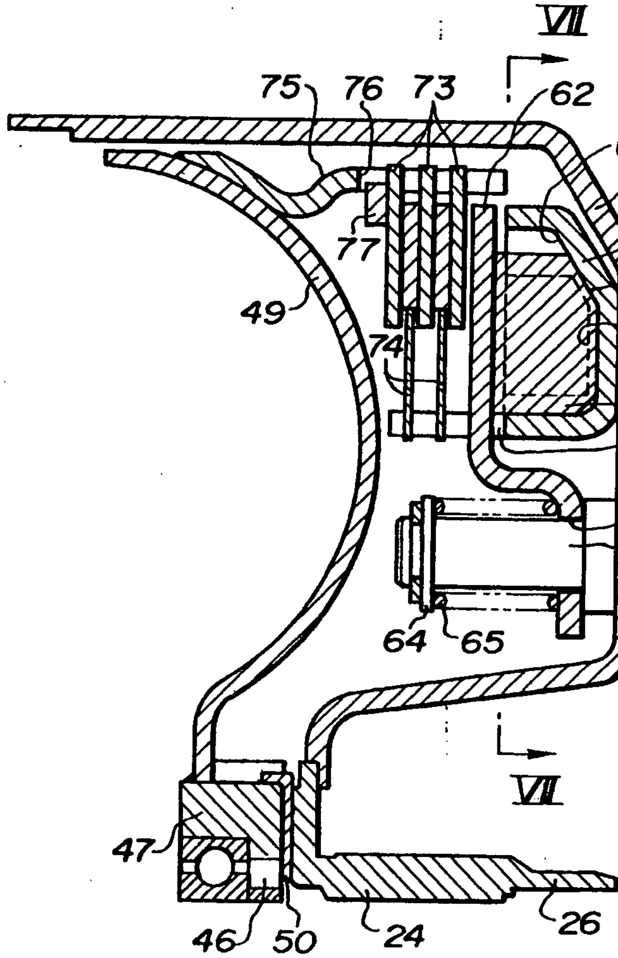
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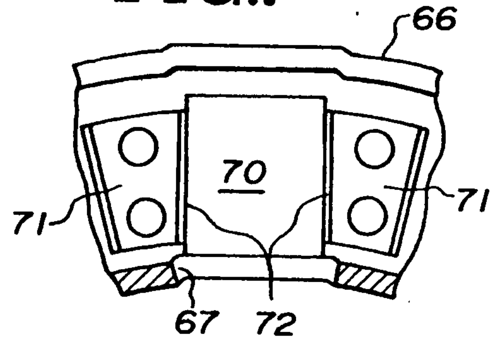
FIG.7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SPECIFICATION
Torque converter

This invention relates to torque converters for industial vehicles such as forklifts, automobiles or the like.

Referring to Fig. 1, which is a schematic sectional partial view of a conventional torque converter, a crank shaft (not shown) or the like of an engine is connected through an input shaft 1 to a shell 2 having impeller blades 3. The shell 2 is provided at its inner periphery with a guide pipe 6. The guide pipe 6 is coaxial with an output shaft 4 and is connected to a gear pump 5 for driving the gear pump 5. A turbine 7 facing the impeller blades 3 is connected to the output shaft 4. A stator 8 is disposed between the impeller blades 3 and the turbine 7. The gear pump 5 is fixed to a transmission housing 9.

When an engine torque is transmitted to the input shaft 1, the shell 2 rotates together with the shaft 1, so that the impeller blades 3 force operating oil to flow in a direction indicated by an arrow X1. The operating oil circulates between turbine blades 7*a*, between stator blades 8*a* and then between impeller blades 3. Thus, the torque of the input shaft 1 is transmitted through the operating oil to the turbine 7, and then to the output shaft 4. On the other hand, the pipe 6 rotates together with the shell 2 and drives the gear pump 5, so that the operating oil is supplied into the torque converter.

However, in the above known structures, the impeller blades 3 as well as the gear pump 5 always rotate when the input shaft 1 rotates. It is impossible to drive the gear pump 5 without driving the impeller blades 3. Consequently, the impeller blades 3 rotate and transmit a slight torque to the output shaft 4 even during an idling drive. Therefore, creep phenomenon may occur in a vehicle, or a braking operation may be required to prevent the creep, which increases engine load. Thus, it may be impossible to provide good driving-ability or operation performance, and fuel consumption increases.

Accordingly, it is an object of the invention to provide an improved torque converter, overcoming the above-noted disadvantages.

With this object in view the present invention provides a torque converter comprising a first shell at an input side; a gear pump always connected to the first shell; a second shell coaxial to the first shell and having impeller blades; and a power transmitting mechanism disposed between both shells and operable to engage when a rotation speed at the input side exceeds a predetermined value.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:—

Fig. 1 is a schematic part sectional view of a known torque converter;

Fig. 2 is a general schematic part sectional view of a preferred torque converter of the invention;

Fig. 3 is a detailed sectional view of one preferred embodient of the torque converter of the invention;

Fig. 4 is a perspective view of part of a support plate of the embodiment of Fig. 3;

Fig. 5 is a perspective view of a shoe of the embodiment of Fig. 3;

Fig. 6 is a detailed sectional view of part of a further preferred embodiment of the torque converter of the invention; and

Fig. 7 is a view along line VII—VII of Fig. 6.

Referring to Fig. 1, the known torque converter comprises a first shell 10 connected to an input shaft 1 and having a guide pipe 6 coaxial to an output shaft 4. The pipe 6 is connected to a gear pump 5 to drive the pump 5. A second shell 11 having impeller blades 3 is disposed inside the first shell 10. A power transmitting mechanism 12 such as a centrifugal clutch or the like is arranged between both shells 10 and 11. The mechanism 12 is operable to disengage when a rotation speed at an input side is lower that a predetermined value and to engage when the speed exceeds the predetermined value. Generally, the above predetermined value is a speed near an idling speed.

According to the above structures, only the gear pump 5 operates during the idling driving because the power transmitting mechanism 12 disengages and does not transmit an input torque to the second shell 11. When a rotation speed of an engine increases to an ordinary running speed from the idling speed, the mechanism 12 engages to transmit the torque to the second shell 11, so that the torque is transmitted through a turbine 7 to the output shaft 4. In this operation, the gear pump 5 also operates.

According to the invention, as stated hereinbefore the first and the second shell 10 and 11, and the power transmitting mechanism 12 are provided. The first shell 10 is always connected to the gear pump 5. The second shell 11 is coaxial to the first shell 10 and has the impeller blades 3. The mechanism 12 is disposed between both shells 10 and 11, and is operable to engage when the input rotation speed exceeds the predetermined value. Therefore, when the input rotation speed is lower than the predetermined value, the torque is not transmitted to the turbine 7 and only the gear pump 5 is driven. Thus, a creep phenomenon is prevented and the engine load can be reduced. Accordingly, a driving feeling and a fuel consumption are improved.

Preferred embodiments of torque converter of the invention will now be described in more detail hereinafter. Referring to Fig. 3, one preferred embodiment comprises a ring 20 bolted to a flywheel (not shown) of an engine and welded to a rotary housing 21. The outer edge of the housing 21 is welded at a portion 23 to an outer edge of a first shell 22. The inner edge of the first shell 22 is welded to an outer edge of a radial flange 25 of a guide pipe 24. Claws 26 are formed at an end of the guide pipe 24. The claws

26 are fitted into narrow portions 29 formed at an inner periphery of gear 28 disposed in a gear pump housing 27, so that the claws 26 may rotate to drive a gear pump 19.

An output shaft 30 is coaxially disposed in the guide pipe 24 with a space therebetween. An end of the output shaft 30 is rotatably fitted into a hollow 32 formed at the center of the rotary housing 21. The output shaft 30 has spline teeth at its outer periphery to which a turbine hub 33 is splined. A turbine runner 35 is fixed to the radially outer portion of the hub 33 by rivets 34.

A stator shaft 37 is disposed coaxially between the guide pipe 24 and the output shaft 30 with spaces therebetween. A supply passage 38 for operating oil 38 is formed between the guide pipe 24 and the stator shaft 37. A return passage 39 for the oil is formed between the stator shaft 37 and the output shaft 30. The stator shaft 37 is provided at its end with outer spline teeth to which an inner race 41 of a one-way clutch mechanism 40 is splined. The mechanism 40 has an outer race 42, a one-way clutch 43 and a one-way clutch retainer 44. A cast stator 45 is rigidly fitted to the outer periphery of the outer race 42. A boss 47 is disposed between the stator 45 and the flange 25 and is rotatably fitted to the stator shaft 37 through a bearing. A space 46 leading to the passage 38 is formed between the boss 47 and the shaft 37. A second shell 49 having impeller blades 48 is welded to the outer periphery of the boss 47. A thrust washer 50 is disposed between the boss 47 and the flange 25 of the guide pipe 24, so that the boss 47 is rotatable relative to the guide pipe 24.

An annular plate 51 extending in a radial direction of the output shaft 30 is fixed at its inner periphery by bolts or welding to a surface of the first shell 22 facing to the second shell 49. As shown in Fig. 4, the plate 51 is provided at its outer periphery with equally spaced recesses 52 opening radially outwardly. As shown in Fig. 3, shoes 53 are disposed radially outside the plate 51. As shown in Fig. 5, each shoe 53 is provided at its inner periphery with a groove 53 and coaxial apertures 55. The grooves 54 is fitted to the plate 51 (see Fig. 3). Pins 56 parallel to the shaft 30 are rigidly fitted to the apertures 55 and slidably fitted to the recesses 52. Thus, the shoes 53 are supported slidably only in the radial direction by the plate 51. A spring seat 57 is formed at inner edge of each shoe 53. An annular extensible coil spring 58 is disposed around the spring seats 57 so as to force the shoes 53 radially inwardly. A lining 59 is fixed to the outer periphery of each shoe 53. A substantially cylindrical casing 60 is disposed around the linings 59 with a space therebetween. One end of the casing 60 is welded to the second shell 49.

One of the specific functions or operations of the torque converter can be as follows. An engine torque is transmitted through the ring 20 and the rotary housing 21 to the first shell 22. In an idling driving condition, centrifugal force generated in the shoes 53 does not expand the coil spring 58, so that the linings 59 do not contact the inner surface of the casing 60. Thus, the torque of the first shell 22 is not transmitted to the second shell 49. On the other hand, the guide pipe 24 fixed to the shell 22 always rotates when the engine drives. Thus, the gear pump 19 always rotates to circulate the operating oil through predetermined portions. When the engine speed increases to an ordinary running value from an idling value, the rotation speed of the first shell 22 also increases, so that the centrifugal force of the shoes 53 increases to expand the spring 58, and the shoes 53 move radially outwardly. Thus, the linings 59 are pressed to the inner surface of the casing 60, and the torque is transmitted to the second shell 49. The torque of the shell 49 is transmitted by the function of the operating oil to the turbine runner 35, and then transmitted to the output shaft 30.

As described above, the torque is not transmitted to the output shaft 30 during idling. Therefore, the creep phenomenon of a vehicle can be prevented. Since, only the gear pump 19 is driven, which is essential for driving the engine, and useless torque is not transmitted to the output shaft 30, the vehicle's fuel consumption is improved.

A further embodiment of the torque converter will now be described with reference to Fig. 6 wherein the same members as those illustrated in Fig. 3 bear the same reference numbers. Plural pins 61 parallel to an output shaft are welded to a surface of a first shell 22 facing to a second shell 49. The pins 61 are slidably fitted into apertures 63 formed at radially inner portions of a pressure plate 62. The end of each pin 61 near the second shell 49 is provided with a spring seat 64. A compressible coil spring 65 is disposed between each spring seat 64 and the plate 62 so as to force the plate 62 away from the second shell 49. A guide plate 66 annularly extending around the group of the pins 61 is welded to the first shell 22. The guide plate 66 has a bent section so that an annular groove or space opening toward the shell 49 may be provided by the plate 66. The guide plate 66 has recesses 67 or slits at its inner cylindrical portion. The plate 62 is fitted to the recesses 67. The radially outer portion of the guide plate 62 forms an inclined annular cam face 68 of which the radially outer portion is more adjacent to the plate 62 than the radially inner portion. Plural weights 70 are annularly disposed between the plates 62 and 66. Each weight 70 has an inclined face 69 corresponding to the cam face 68.

Referring to Fig. 7, respective guides 71 (only one is illustrated) are disposed between respective weights 70. The guides 71 are rivetted or welded to the guide plate 66. Each weight 70 is supported radially slidably by two side faces 72 of the guides 71, 70 facing to each other.

Referring again to Fig. 6, a group of the friction plates 73 and 74 are disposed oppositely to the weights 70 with the pressure plate 62 therebetween. There are two input friction plates

74 and they are arranged between the three output friction plates 73. The radially inner portions of the plates 74 are axially slidably fitted into the recesses 67 of the plate 66. The radially outer portions of the plates 73 are fitted axially slidably into recesses 76 provided in a substantially cylindrical casing 75. A snap ring 77 is fixed to an inner peripheral portion of the casing 75 near the second shell 49 so as to support the plates 73 and 74 forced by the plate 62. The casing 75 is welded to the second shell 49.

The operation of this embodiment is as follows.

In an idling driving, a rotation speed of the shell 22 is low and only a small centrifugal force is generated in the weights 70. Therefore, the weights 70 do not move radially outwardly on the cam face 68 of the guide plate 66 and do not force the pressure plate 62 toward the friction plate 74. Thus, the plates 73 and 74 do not engage with each other, and no torque is transmitted from the first shell 22 to the second shell 49.

When the rotation speed of the engine increases from an idling value to an ordinary running value, the rotation speed of the first shell 22 increases, and the centrifugal force in the weights 70 increases. Therefore, the weights 70 move radially outwardly on the cam face 68 to press the pressure plate 62 against the friction plate 74 with consequent compressing of the coil spring 65. Thus, the plates 73 and 74 frictionally engages with each other, and the torque is transmitted from the first shell 22 to the second shell 49.

In this embodiment, similarly to the embodiment illustrated in Fig. 3, such advantages can be obtained that a creep phenomenon is prevented in a vehicle and that its fuel consumption is improved.

Such mechanisms may be employed instead of the centrifugal clutches as the power transmitting mechanism that comprise a hydraulic clutch, and an electromagnetic clutch or the like disposed between the first shell 22 and the second shell 49. In this mechanism, the clutch is controlled by a control means connected to a sensor means detecting a rotation speed of a crank shaft or the like, so that the clutch disengages when the rotation speed is lower than a predetermined value, and engages when the rotation speed exceeds the predetermined value.

Although the invention has been described in its preferred forms with a certain degree of particularity, it is understood that the present disclosure of the preferred forms can be changed in the details of construction and the combination and arrangement of parts without departing from the aim and the scope of the invention as hereinafter claimed.

Claims

1. A torque converter comprising a first shell at an input side; a gear pump always connected to the first shell; a second shell coaxial to the first shell and having impeller blades; and a power transmitting mechanism disposed between both shells and operable to engage when a rotation speed at the input side exceeds a predetermined value.

2. A torque converter as claimed in claim 1 wherein said power transmitting mechanism is a centrifugal clutch comprising a support member fixed to the first shell, a shoe provided at its outer periphery with a lining and supported slidably only in a radial direction of the shells by the support member, and a casing disposed around the shoe and fixed to the second shell; and the shoe is adapted to move radially outwardly to a position in which the lining is pressed to the casing, when a rotation speed of the first shell exceeds the predetermined value.

3. A torque converter as claimed in claim 1 wherein said power transmitting mechanism is a centrifugal clutch comprising an input friction plate connected to the first shell, an output friction plate connected to the second shell, a pressure plate operable to force the friction plates in a pressing direction of the friction plates, a forcing means forcing the pressure plate oppositely to the pressing direction, a weight for forcing the pressure plate in the pressing direction, and a guide means supporting the weight so that the weight may rotate together with the first shell and may be movable in radial and axial directions of the torque converter; the weight and the guide means are provided with cam faces contacting each other, so that the weight may be guided by the cam faces and force the pressure plate when the weight moves radially outwardly.

4. A torque converter as claimed in claim 1 wherein said power transmitting mechanism is a clutch connected through a control means to a sensor detecting the rotation speed at the input side, so that the control means may control engaging and disengaging operations of the clutch in accordance with signals by the sensor.

5. A torque converter substantiallly as hereinbefore described with reference to and as illustrated in Figs. 2, 3, 4 and 5, or in Figs. 2, 6 and 7.

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